Energy
Volume 208, 1 October 2020, 118255

Mathematical modeling of a system composed of parabolic trough solar collectors integrated with a hydraulic energy storage system

Luis Sebastián Mendoza Castellanos [a, b], Ana Lisbeth Galindo Noguera [a, b], Elkin I. Gutiérrez Velásquez [c], Gaylord Enrique Carrillo Caballero [b, d], Electo Eduardo Silva Lora [b], Vladimir Rafael Melian Cobas [b]

Show more

https://doi.org/10.1016/j.energy.2020.118255

Abstract

In this work we propose to model a 7.5 kWe power generation system, implementing a Parabolic Trough Collector system, coupled to an Organic Rankine Cycle (PTC/ORC) and a bladder-type hydraulic accumulator system. The purpose of the research is to evaluate the behavior of the hydraulic accumulation system made up of 22 bladder-type accumulators of 60 L each, which operates as a backup to provide continuity in the generation of electrical energy. The model allows evaluating and analyzing the loading and unloading behavior of a hydraulic accumulator system, for intermittent conditions of solar irradiation, wind speed, and ambient temperature. The results show that for a power deficit in the system of 0.5 kWe, the compensation time for the generation of electrical energy would be 1 h and 51 min and for a deficit of 7 kWe, the compensation time would be 4 min. The model was designed as a convenient tool for dimensioning and integrating various energy sources in hydraulic accumulation systems and will allow analyzing the behavior of hydraulic accumulators as an energy backup system.